KEY

First Name:_____ Last Name:_____

L04 – Worksheet – Coulomb's Law Examined Graphically

Textbook Questions

None

Diploma Worksheet Questions – Coulomb's Law (Basic Definitions)

Q89: The relationship between the electrical force, *F*, on two small, charged objects and their distance of separation, *r*, is represented by

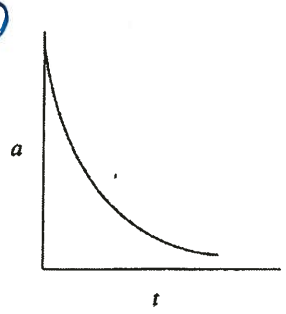
$F = \frac{kq_1q_2}{r^2}$ so $F \propto \frac{1}{r^2}$

a. $F \propto r$
b. $F \propto 1/r$
c. $F \propto r^2$
(d.) $F \propto 1/r^2$

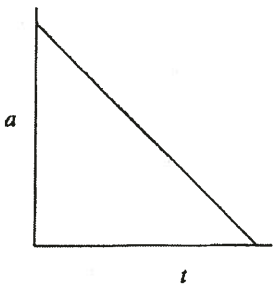
Diploma Worksheet Questions – Coulomb's Law (Graphing)

Q123: Two positively charged objects are held close together on a frictionless surface. If one of the objects is released, the acceleration of the released object can be represented by graph

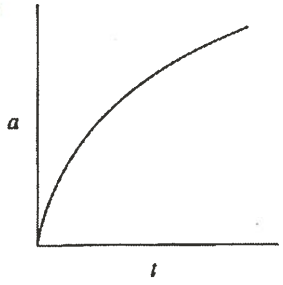
(A.)



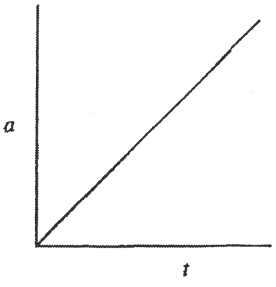
X

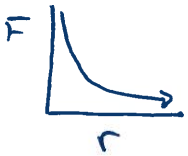


X



X



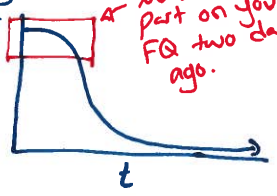


$F = ma$

If F decreases, so does accel.

No matter how faraway, there will still be a force. It never goes to zero.

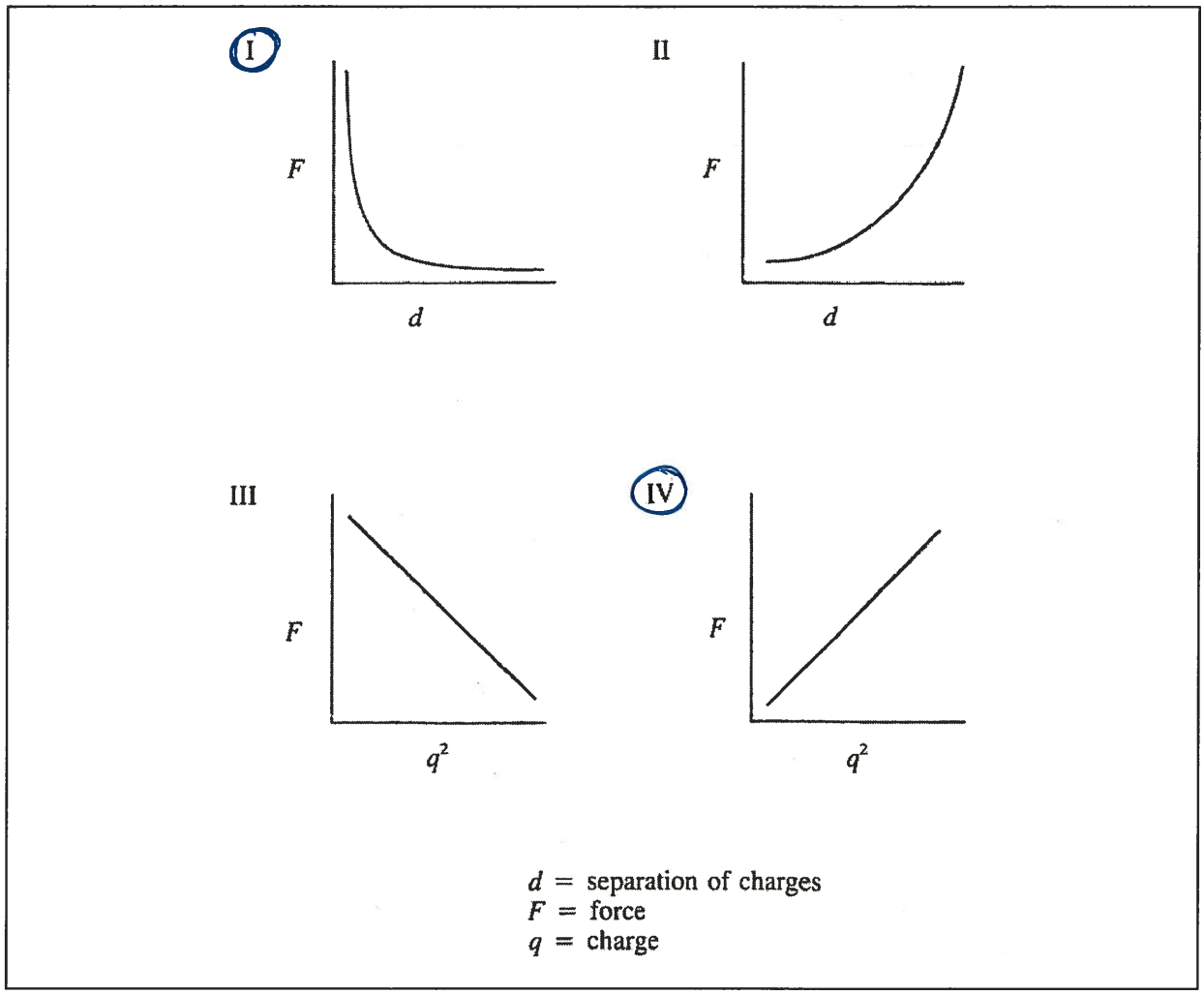
Note that an F-t graph actually looks more like F



You saw this part on your FQ two days ago.

Key

Use the following information to answer Q122:



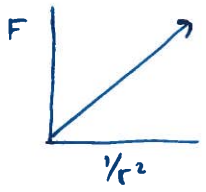
Q122: Which graph illustrates Coulomb's law?

a. I and II
b. I and IV
c. II and III
d. III and IV

$F = \frac{kq_1q_2}{r^2}$

$F = (kq_1q_2)\frac{1}{r^2} + 0$

$y = (m)x + b$

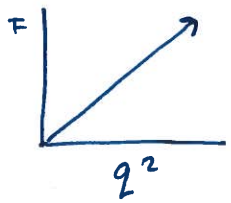


Whoops! Not an option.

$F = \frac{kq_1q_2}{r^2}$

$F = \left(\frac{k}{r^2}\right)q^2 + 0$

$y = (m)x + b$



KEY

Diploma Worksheet Questions – Coulomb's Law (Algebra)

Q132: Two charged bodies repel each other with a force of *F*. The charge on one is doubled, and the charge on the other is increased by a factor of 7/3. If the distance between them is then tripled, the final resulting force would be

a. 42*F*
b. 14*F*/3
c. 14*F*/27
d. *F*/9

$F = \frac{kq_1q_2}{r^2}$

$F_{new} = \frac{k(2q_1)(\frac{7}{3}q_2)}{(3r)^2} = \frac{\frac{14}{3}kq_1q_2}{9r^2}$

$= \frac{14}{27}\left(\frac{kq_1q_2}{r^2}\right)$

$= \frac{14}{27}(F_{original})$

Q141: The magnitude of the force between two charged particles that are a fixed distance apart is 3.80×10^{-4} N. If the distance between their centers is exactly doubled, then the magnitude of the force between the particles, expressed in scientific notation, is ***a.bc*** $\times 10^{-d}$ N. The values of ***a, b, c,*** and ***d*** are ___, ___, ___, and ___.

*(Record your **four digit** answer in the Numerical Response boxes below)*

9	5	0	5

$F = \frac{kq_1q_2}{r^2}$

$F_{new} = \frac{kq_1q_2}{(2r)^2} = \frac{1}{4}\left(\frac{kq_1q_2}{r^2}\right)$

$= \frac{1}{4}(3.80 \times 10^{-4})$

$= 9.50 \times 10^{-5}\ N$

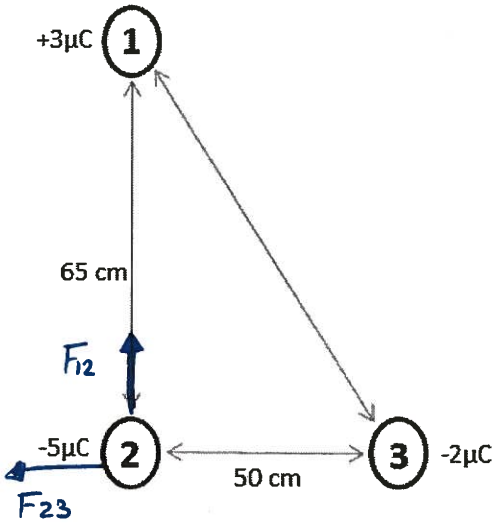
Key

Challenge Questions

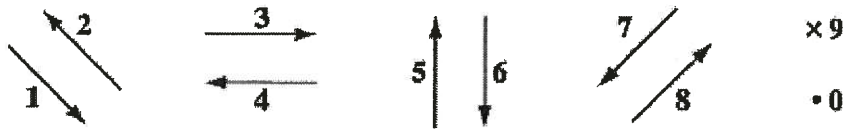
Use the following information to answer Q1 and Q2:

Three Point Charges

Three point charges are arranged according to the diagram below. Charge **2** experiences a force due to the presence of Charge **1** and Charge **2**.



Directions



Q1: Use the vector directions above to fill in the blanks below.

Direction:	5	4	2
Description:	**Direction of Force acting on Charge 2 due to Charge 1**	**Direction of Force acting on Charge 2 due to Charge 3**	**Direction of Net Force acting on Charge 2**

*(Record your **three-digit** answer in the Numerical Response boxes below)*

5	4	2	

KEY

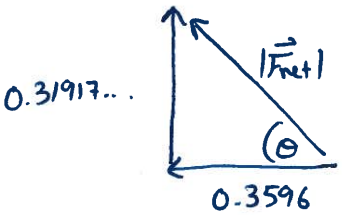
Q2: The magnitude of the net electrostatic force acting on Charge 2 is ***a.bc*** x 10^{-d} N, where ***a, b, c,*** and ***d*** are ___, ___, ___, and ___.

*(Record your **four-digit** answer in the Numerical Response boxes below)*

4	8	1	1

$F_{12} = \frac{(8.99\times10^{9})(3\times10^{-6})(5\times10^{-6})}{(0.65)^2} = 0.319171597633\ N$

$F_{23} = \frac{(8.99\times10)(5\times10^{-6})(2\times10^{-6})}{(0.50)^2} = 0.3596\ N$



$a^2+b^2=c^2$

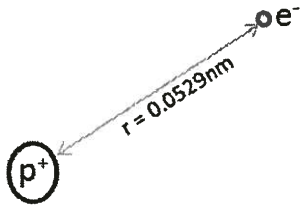
$|\vec{F}_{net}| = 0.480814588\ 73N$

$\approx 4.81\times10^{-1}\ N$

$a.bc\times10^{-d}$

Use the following information to answer Q3:

A neutral Hydrogen atom contains a single proton and a single electron in the ground state. According to the Bohr model of the atom, the orbital radius of the electron is 0.0529nm.



*NOTE: The diagram is **not** drawn to scale.*

Q3: The ratio of the electrostatic force to the gravitational force that an electron in the ground state around a Hydrogen atom experiences is ***a.b*** x 10^{cd} : 1, where ***a, b, c,*** and ***d*** are ___, ___, ___, and ___.

*(Record your **four- digit** answer in the Numerical Response boxes below)*

2	3	3	9

$F_e = \frac{kq_1q_2}{r^2} = \frac{(8.99\times10^{9})(1.60\times10^{-19})(1.60\times10^{-19})}{(0.0529\times10^{-9})^2}$

$F_e = 8.224098684\ 61\times10^{-8}\ N$

$F_g = \frac{Gm_1m_2}{r^2} = \frac{(6.67\times10^{-11})(9.11\times10^{-31})(1.67\times10^{-27})}{(0.0529\times10^{-9})^2}$

$F_g = 3.626179\ 83069\times10^{-47}\ N$

$F_e : F_g$

$8.224...\times10^{-8} : 3.626...\times10^{-47}$

$\div 3.626\times10^{-47} \quad \div 3.626\times10^{-47}$

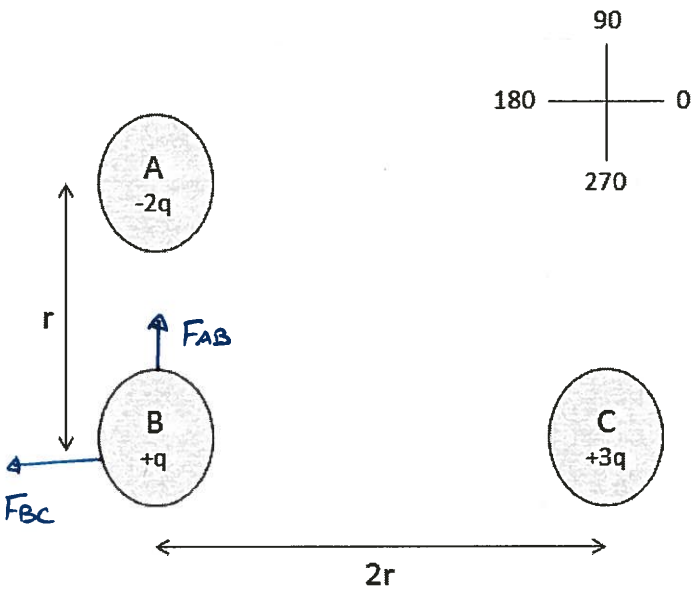
$2.267978\ 71827\times10^{39} : 1 \Rightarrow \approx 2.3\times10^{39} : 1$

Electrostatic force is way stronger than gravity!!!

KEY

Use the following information to answer Q4:

Three charges are aligned at right angles, per the diagram below.



Q4: The net force acting on *B* will be at ____ degrees.

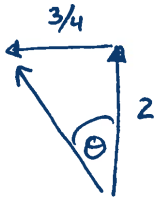
*(Record your **three digit** answer in the Numerical Response boxes below)*

1	1	1	

$$F_{AB} = \frac{k(2q)(q)}{r^2} = \frac{2kqq}{r^2} = 2\left(\frac{kqq}{r^2}\right)$$

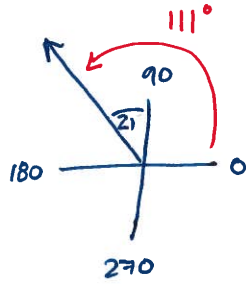
$$F_{BC} = \frac{k(q)(3q)}{(2r)^2} = \frac{3kqq}{4r^2} = \frac{3}{4}\left(\frac{kqq}{r^2}\right)$$

Drawn to scale.



$$\text{Tan}\,\theta = \frac{0.75}{2}$$

$$\theta = 20.556^\circ$$

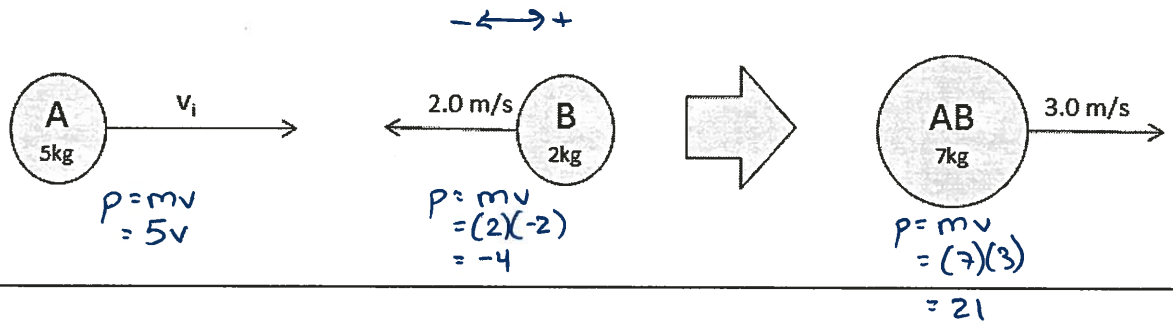


Key

Cumulative Review from Previous Units

Use the following information to answer Q1:

Two rolling lumps of clay collide on a frictionless surface. They stick together, and travel in the positive direction at 3.0m/s, as depicted below.



Q1: Object *A* has an initial speed of _____ m/s.

*(Record your **three digit** answer in the Numerical Response boxes below)*

5	.	0	0

$p_i = p_f$

$(5v) + (-4) = (+21)$

$5v - 4 = 21$

$+4 \quad +4$

$5v = 25$

$\div 5 \quad \div 5$

$v = 5$

$v \simeq 5.00$ m/s